SECTION 03740

STRUCTURAL CRACK REPAIR BY EPOXY INJECTION

PART 1 - GENERAL

0.1 DESCRIPTION OF WORK

A. Work Included: This Section specifies structural bonding of designated cracks and voids in concrete structures by penetration of epoxy adhesive.

0.2 SUBMITTALS

A. Manufacturers' Literature: Submit manufacturers' literature completely describing products.

B. Installation Instructions: Submit manufacturers' application instructions.

C. Qualifications of Installer: Submit applicator’s qualifications.

0.3 QUALITY ASSURANCE

A. Applicators' Qualification: Applicators shall demonstrate experience on at least three similar structural repairs of 1000 linear feet minimum each, and has performed satisfactorily for a minimum period of three years.

0.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials clearly marked with legible and intact labels with manufacturer's name and brand name, and identifying contents of containers.

B. Store materials in areas where temperatures and protection from the elements conform with manufacturer's recommendations and instructions.

0.5 JOB CONDITIONS

A. Environmental Requirements. Comply with manufacturer's recommendations.

B. Protection

1. Protect surrounding work, vehicles, planting materials and items of similar nature, from damage by epoxy injection materials and operations.
2. When working with epoxy injection materials, comply with manufacturer's safety recommendations and instructions.

PART 2 - PRODUCTS

0.1 EPOXY

A. Type: Two-component, non-solvent, low-viscosity epoxy adhesive system containing minimum 100 percent solids with no dilutents, wetting agents or volatile solvents, capable of being injected under pressure into cracks as small as 0.002 inch wide to their full depth, complying with ASTM C881 except as specified herein.

B. Physical Characteristics: Following are required properties of cured materials at 77 degrees F

Physical Properties	Requirements or Limits
1. Flexure Strength, ASTM D790:	10,000 psi minimum
2. Tensile Strength, ASTM D638:	8,000 psi minimum
3. Compressive Modulus, ASTM D695:	20,000 psi minimum range
4. Compressive Yield Strength, ASTM D695, 7 days at 70 degrees F.:	15,000 psi minimum
5. Elongation at Break, ASTM D638, 7 days at 70 degrees F.:	4.0 percent maximum
6. Slant Shear Strength, AASHTO T-237, cured one day at 77 degrees F.:	No failure of adhesive at 5,000 psi.
7. Bond Strength, ASTM C321, 6 hours at 70 degrees F.:	500 psi minimum

8. Viscosity, cP, Brookfield RVT Spindle No. 4, at 20 rpm: a. Part A at 40 ± 3 degrees F.: b. Part A at 77 ± 3 degrees F.: c. Part B at 40 ± 3 degrees F.: d. Part B at 77 ± 3 degrees F.:	 6,000 – 8,000 400-700 1,000 – 1,400 140 - 340

PART 3 - EXECUTION

0.1 EQUIPMENT FOR METERING, MIXING, AND INJECTING

A. Type: The equipment used to meter and mix the two injection adhesive components and inject the mixed adhesive into the crack shall be portable, positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle. The pumps shall be electric or air powered and shall provide in-line mixing and metering system, and shall contain drain-back plugs.

B. Discharge Pressure: The injection equipment shall have the capability of discharging the mixed adhesive at pressures up to 200 psi and maintaining that pressure.

C. Ratio Tolerance. The equipment shall have the capability of maintaining the mix ratio for the injection adhesive prescribed by the manufacturer of the adhesive within a tolerance of plus or minus 5 percent by volume at any discharge pressure up to 200 psi.

0.2 INSPECTION

A. Surfaces shall be dry or damp, free of standing water.

B. Surfaces shall be free of dirt, dust, paint, grease, oil, rust or other foreign matter which would interfere with adhesion of epoxy materials.

C. Measure the width of each crack to be repaired and determine the correct epoxy material and correct injection pressure.

0.3 PREPARATION

A. Clean surfaces adjacent to cracks or other areas of application of dirt, dust, grease, oil, efflorescence or other foreign matter detrimental to application of epoxy injection surface seal system.

B. Clean such surfaces with surface cleaner in accordance with manufacturer's recommendations and instructions.

C. Clean out cracks of all laitance with pressurized air or the equivalent.

0.4 APPLICATION

A. Application of Surface Seal

1. Seal cracks to be injected with surface sealer material in such manner that no defacing or discoloration of concrete surfaces shall result.
2. Provide entry ports in surface seals spaced not greater than crack depth center to center, but provide additional entry ports spaced as required to accomplish travel of injected material between ports and fill cracks completely with epoxy. At walls open on both sides, provide entry ports on opposite sides of walls at staggered elevation.

B. Epoxy Injection: Verify the selected epoxy is suitable for applications required (vertical, horizontal and overhead application as applicable).

1. Inject epoxy under constant pressure in accordance with procedures as recommended by manufacturer or as required to obtain 100 percent penetration of cracks without inclusion of air pockets or voids in epoxy and as required to achieve structural bonding.
2. Begin injection of epoxy at lower entry port and continue until there is an appearance of epoxy at entry port directly adjacent to or above entry port being pumped, thus indicating epoxy travel.
3. When epoxy travel is indicated, discontinue injection on entry port being pumped, seal it, and transfer epoxy injection to next adjacent port.
4. Perform epoxy injection continuously until cracks are completely filled.
5. Finishing Requirements
    a. When cracks are completely filled, cure epoxy for sufficient time to allow removal of surface seal without any draining or runback of epoxy material from cracks.
    b. Remove surface seals and clean concrete surfaces with epoxy injection system cleaners as required to produce flush, inconspicuous surface having identical appearance and finish as adjoining concrete, showing no indentations or evidence of entry port fitting materials or procedures, and having appearance acceptable to the Engineer.
6. Special Requirements

a. If Penetration of Cracks is Impossible: Immediately notify the Engineer.
b. Modifications to Epoxy Injection Installation Procedures: If in order to achieve required penetration of areas being injected, epoxy injection installation procedures specified herein require modification, submit such modifications to the Engineer for acceptance prior to recommencing work.

C. Filling of Field Control Testing Core Holes. This procedure consists of using two-component bonding agent applied to surfaces of cored holes followed by application of grout mix placed by hand trowel, thoroughly rodded and tamped in place, and finished to match color, finish and texture of existing concrete to the satisfaction of the Engineer. Submit materials and procedures required to the Engineer for acceptance before proceeding with the work.

0.5 FIELD QUALITY CONTROL

A. Visual Inspection: Inspect each application for visual confirmation that application was performed correctly.

B. Pressure Check Test

1. Method. The mixing head of the injection equipment shall be disconnected and the two-adhesive component delivery lines shall be attached to the pressure check device. The pressure check device shall consist of two independent valved nozzles capable of controlling flow rate and pressure by opening or closing the valve. There shall be a pressure gauge capable of sensing the pressure build-up behind each valve. The valves on the pressure check device shall be closed and the equipment operated until the gauge pressure on each line reads 200 psi. The pumps shall be stopped and the gauge pressure shall not drop below 190 psi within 3 minutes.
2. Frequency of Pressure Check Test. The pressure check test shall be run for each injection unit at the beginning and at the end of every day that unit is used in the work of crack repair.

C. Tests for Proper Ratio

1. Method. The mixing head of the injection equipment shall be disconnected and the two adhesive components shall be pumped simultaneously through the ratio check device. The ratio check device shall consist of two independent valved nozzles capable of controlling flow rate and back pressure by opening or closing the valve to restrict material flow. There shall be a pressure gauge capable of sensing the back pressure behind each valve. The discharge pressure shall be adjusted to 200 psi for both adhesive components. Both adhesive components shall be simultaneously discharged into separate calibrated containers. The amounts discharged into the calibrated containers simultaneously during the same time period shall be

compared to determine the mix ratio. After the test has been completed at a 200 psi discharge pressure the procedure shall be repeated for 0 psi discharge pressure.

2. Frequency of Test for Proper Ratio. The ratio test shall be run for each injection unit at the beginning and at the end of every day that unit is used in the work of crack repair.

3. Proof of Ratio and Pressure Check

4. At all times during the course of the work the Contractor shall keep complete and accurate records available to the Engineer of the pressure and ratio check tests specified above.
5. In addition, the Engineer at any time without prior notification of the Contractor may request the Contractor to conduct the tests specified above in the presence of the Engineer.

PART 4 - MEASUREMENT AND PAYMENT

0.1 MEASUREMENT

A. Structural crack repair by epoxy injection will be measured as per linear foot complete in place, including all accessories and incidentals.

0.2 PAYMENT

A. Payment for structural crack repair by epoxy injection will be made at the Contract unit prices for the quantities as specified above.

0.3 PAYMENT ITEMS

ITEM NO.	DESCRIPTION	UNIT
0354.011	STRUCTURAL CRACK REPAIR BY EPOXY INJECTION	LF

END OF SECTION

NOTES TO THE DESIGNER

A. Any request to modify or waive the specification requirements listed below must be approved in writing by the MBTA's Director of Design:

1. None.